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Biofuel: An Urgency in Urban Transportation

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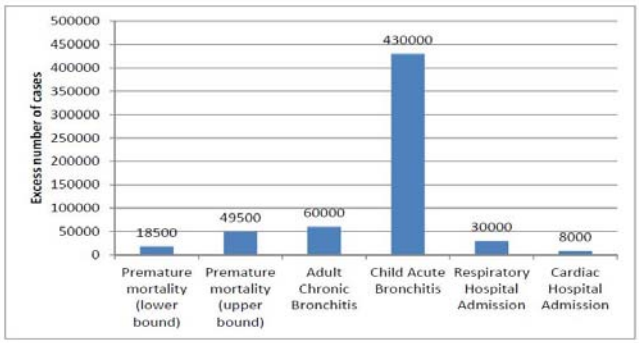
Abstract—*In our country and all other developing countries transportation has been primarily dependent on non-renewable source of energy like fossil fuels, petroleum etc. which are limited in quantity. Rapidly Increasing numbers of motorized vehicles in metro cities like Delhi has led to hazardous environmental pollution, which takes lives of millions of people every year by creating lungs problems, cancer and blood pressure abnormalities. Though it is too late but still some time is left to think about alternative solutions to protect environment and future generations. This paper presents BIOFUEL as one of the alternatives of conventional fuel energy used in motorized vehicles to counter the problems of air pollution. Biofuel have multidimensional benefits to the society. It can increase environmental sustainability and have great potential to generate large number of employment opportunity in both urban and rural areas. It can strengthen the rural economy by cultivation of biomass used in making of biofuel, which will help in countering the rural urban migration, and will have positive effect directly on process of urbanization and indirectly on urban environment. Making suitable policies for the promotion and Controlled cultivation of plant species of desired biomass for the production of biofuel can be very much beneficial with countering its possible drawbacks.*

1. INTRODUCTION

Increasing urban population in India and all other developing countries have increased motorized vehicle on the road drastically. Total number of registered vehicle in Delhi was 6451883 in 2009-10 which become 7438155 in 2011-12.Most of these motorized vehicle are run by using petroleum product like diesel and petrol which emits hazardous pollutant like carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), carbon monoxide (CO), and sulphur dioxide (SO2), oxides of nitrogen (NOx), particulate matter (PM) and non-Methane volatile organic compounds. [1] In Delhi, vehicles have been estimated to contribute maximum (67%) to the total pollution load, followed byPower plants (13%), industries (12%) and domestic sector (8%).Similarly, the contribution of Vehicles to urban air pollution is 52% in Bombay and close to one-third in Calcutta.[2]Primary emissions of NO2, CO and VOC from vehicles are also responsible for ground level O3 formation by photochemical reaction which is responsible for allergic asthmatics by augmenting allergic responses. [3] Emission of SO2, PM, NO and acid aerosols also cause inflammation of bronchial mucous.[4]The health impact analysis estimates up to 49,500 deaths in 2010 and 158,500 in 2030 due to road transport in India. The results of health risk analyses study conducted by Guttikunda and Jawahar, (2012) is given in Fig. 1. Even though these are estimated the direct impacts of urban traffic emissions but they mentioned emission indirectly responsible for increased inflammation, cardiac conditions, decreased cancer, fertility, and premature birth.



Source: Guttikunda and Jawahar, (2012)

Fig. 1: Traffic emission and associated health effects estimation in India

[5]In India, exposure to PM is estimated to contribute to over 100,000 premature deaths annually. This number will grow steeply in future if we will not pay keen attention on increasing air pollution due to petroleum fuel used in running of vehicle. We must look for alternative source of energy for motorized vehicles, to counter the worsening scenario of air pollution and biofuel can be one of them.

2. BIOFUEL

Fuels derived from biomass are biofuels. Biomass is organic matter produced by plants and animals. It comprises mainly, agricultural crops and products, wood, aquatic plants, forestry products, wastes and residues, and animal wastes. In its most general words, biofuels are all types of solid, gaseous and liquid fuels that can be derived from biomass. Examples of solid biofuels include wood, charcoal and bagasse. Wood and charcoal are widely used as fuel for domestic purposes such as cooking in the rural areas of most developing countries. Waste bagasse, the fibrous material produced from sugarcane processing, is extensively used for steam and electrical power generation in raw sugar mills. Examples of gaseous biofuels

include methane gas and producer gas. Methane gas is produced from the anaerobic fermentation of animal wastes, wastewater treatment sludge and municipal wastes in landfills. On the other hand, producer gas can be made from the pyrolysis or gasification of wood and agricultural wastes. Examples of liquid biofuels include methanol, ethanol, plant oils and the methyl esters produced from these oils commonly called bio diesel.

2.1. Fuel Ethanol

[6]Ethanol is a type of alcohol that has many properties similar to the gasoline. These similarities make ethanol a highly attractive fuel for useas a gasoline substitute or as an alternative fuel. The densities ofethanol and gasoline are almost identical although the energy content of ethanolis about 30% lower. On the other hand, since ethanol contains molecular oxygenthat promotes more complete combustion, so the difference in energy content does a major concern.

2.2. Biodiesel

[6]Biodiesel is produced through a series of physical and chemical processingof the fruits, seeds, or parts of oil-containing plants. The first step usually involves the extraction of the crude oil. This step may involve several different types ofoperations or processes depending on the kind of feedstock.[6]Biodiesel dramatically reduces air toxins, carbon monoxide, soot, small particles, and hydrocarbon emissions by 50% or more, reducing the cancer-risk contribution of diesel up to 90% with pure biodiesel. Air quality benefits are roughly proportional for diesel/biodiesel mixtures. Biodiesel's superior lubricity helps reduce engine wear, even as a small percentage additive. The most common use of biodiesel is as B20 (20%biodiesel, 80% diesel) and B2 (2% biodiesel, 98% diesel) or B1 (1% biodiesel, 99% diesel). The use of these blends requires no engine modifications.

3. COMPARISON OF BIOFUEL AND PETRO FUEL:

Biofuel are much better in overall aspect of environment energy, climate change.

3.1. Emission

As graph suggest vehicle run by biodiesel emits 77% less CO2, 90 % less

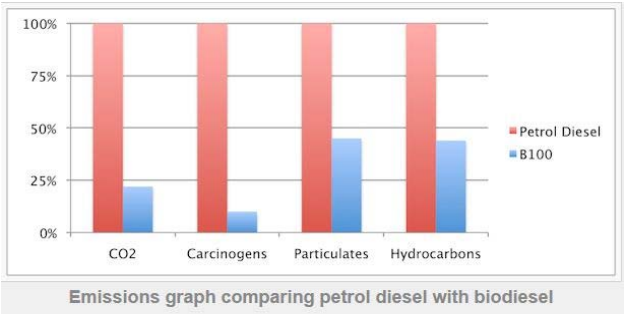


Fig. 2: Source:http://www.grtmaldives.com/

Carcinogens, 60 % less particulates, and 60% less hydrocarbon. This data shows goodness of biofuel upon petroleum.

3.2. Energy

Biodiesel and petroleum diesel have similar energy efficiencies. [7]The life cycle energy efficiencies of 80.55% for biodiesel and 83.28% for petroleum diesel. The lower efficiency for biodieselReflects slightly higher process energy requirements for converting the energy contained in soybean oil to fuel. In terms of effective use of fossil energy resources, biodiesel yields around 3.2 units of fuel product energy for every unit of fossil energy consumed in the life cycle. By contrast, petroleum diesel's life cycle yields only 0.83 units of fuel product energy per unit of fossil energy consumed. Such measures confirm the reversible nature of biodiesel.

3.3. Water and Solid Waste

The water wastage in the production of petroleum fuel is very much then the biodiesel. [7]Biodiesel life cycle waste water flows are almost 80% lower than those of petroleum dieselBiodiesel is also responsible for only about 5% of the hazardous waste generated by petroleum die

4. SCOPE OF PRODUCTION OF BIOFUEL IN INDIA

There is large scope of production of biofuel in the form of biodiesel and bioethanol in India, because of following reason.

4.1. Land Availability

The govt. of India has sufficient land for the production of bio diesel and bio ethanol. Accordingto the *Wasteland Atlas of India* (GOI 2005), there are 55.37 million ha of wastelands in India.

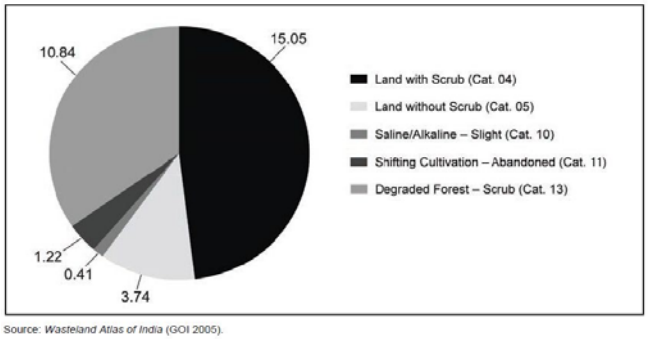


Fig. 3: Categories of Wasteland Suitable for Biodiesel Plantation(million hectares)

4.2 Water availability

Oilseed plantations do not require much irrigation as oilseeds can be grown on dry wasteland. The oilseed plants, such as Jatropha, should be grown in areas with a minimum rainfall of 600 millimeters (mm). Many experts believe that in drier areas

some limited irrigation may be required to establish biodiesel crops. Seedlings and saplings in nurseries need water to grow. Saplings grown for 4–6 months do not require additional irrigation if they are planted in the monsoon season in areas with reasonable rainfall (600 mm and above).

4.3. Availability of biomass

Biomass availability in India is estimated at about 500 million tons per year covering residues from agriculture, processing industries, and forestry (however, some research studies estimate biomass availability to be higher than 500 million tons). This estimate is based on a survey by the Indian Ministry of New and Renewable Energy, which indicates that 15 to 20 percent of total crop residues could be used for ethanol generation without altering the primary crops' present uses.

4.4. Man Power

Man power is neededfor cultivation of biomass and for production of biofuel form biomass, butthere is no lack of man power in our country.In India more than 65% of people live in rural area that primarily depend on agriculture for income.

5. MULTIDIMENSIONAL ADVANTAGE OF BIOFUEL PRODUCTION

5.1. Environment and climate

Reduced emission of harmful pollutants Ethanol and biodiesel are both oxygenated compounds containing no sulphur. These fuels do not produce sulphur oxides, which lead to acid rain formation. Sulphur is removed from petrol and diesel by a process called hydro-desulphurization. The hydro-desulphurization of diesel causes a loss in lubricity, which has to be rectified byintroducing an additive. Biodiesel is a natural property of lubricant and thus no lubricity-enhancing additive is required. Since ethanol and biodiesel contain oxygen, the amount of carbon monoxide (CO) and unburnt hydrocarbons in the exhaust is reduced. [8]With the introduction of ethanol in Brazil, CO emission from automobiles decreased from 50 g/km in 1980 to 5.8 g/km in 1995. The emission of nitrogen oxides (NOx) from biofuels is slightly greater when compared to petroleum, but this problem can be ameliorated by using de-NOx catalysts which work well with biofuels due to the absence of sulphur

5.2. Reduction in greenhouse gas emissions

The net CO2 emission of burning a biofuel like ethanol is zero since the CO2 emitted on combustion is equal to that absorbed from the atmosphere by photosynthesis during the growth of the plant (sugarcane) used to manufacture ethanol

5.3. Employment opportunity

At the beginning of the new millennium, 260 million people in India did not have access to a consumption basket which defines the poverty line. India is home to 22 per cent of the poor people in the world. The biofuels sector has the great potential to serve as a source of employment.[9] The investment in the ethanol industry per job created is $11,000, which issignificantly less than the $220,000 per job in the petroleum field. In India, the sugar industry, is the backbone of ethanol production, which is the biggest agroindustry in the country.[10] The sugar industry is the source of the livelihood of 45 million farmers and their dependents, comprising 7.5 per cent of the rural population. Other half a million people are employed as skilled or semi-skilled laborers in sugarcane cultivation

5.4. Energy security

India has sixth rank in the world in terms of energy demand, accounts 3.5 per cent of the world commercial energy demand in 2001. But at 479 kg of oil equivalent, the per capita energy consumption is still very low, and the energy demand may grow at the rate of 4.8 per cent per annum. India's domestic production of crude oil currently satisfies only about 25 per cent of this consumption. Dependence on imported fuels made many countries vulnerable to disruptions in supplies which may result in physical challenges and economic burdens. The fluctuation of oil prices poses great risks for the world's economic and political stability, with unusually dramatic effects on energy-importing developing nations. Renewable energy, including biofuels, can help in energy supply and increase energy security.

5.5. Improved social well-being

A large part of India's population, mostly in rural areas, does not have access to energy services. The enhanced use of renewables (mainly biofuels) in rural areas is closely linked to poverty reductions because greater access to energy services can improve access to pumped drinking water. Potable water can reduce hunger by allowing for cooked food (95 per cent of food needs cooking); Reduce the time spent by women and children on basic survival activities (gathering firewood, fetching water, cooking, etc.); Allow lighting which increases security and enables the night time use of educational media and communication at school and home; and Reduce indoor pollution caused by firewood use, together with a reduction in deforestation

5.6. Good fuel properties

Ethanol has a research octane number of 120, much higher than that of petrol. Thus, ethanol blending increases the octane number without having to add a carcinogenic substance like benzene or a health-risk posing chemical like methyl tertiary butyl ether (MTBE).[8]The energy content of ethanol is only 26.9 MJ/kg compared to 44.0 MJ/kg for petrol. This would suggest that the fuel economy of a petrol powered engine would be 38.9 per cent higher than that of an ethanol-powered engine. In actuality, this difference is 30 per cent since ethanol engines can run more efficiently (at a higher compression ratio) because of the higher octane rating. Ethanol's higher

latent heat of vaporization and greater propensity to absorb moisture may lead to engine starting and corrosion problems, respectively, but none of these problems have manifested in the millions of hours of running automobile engines in Brazil.

6. INITIATIVE SHOULD BE TAKEN TO PROMOTE BIOFUEL

-Govt. should make the policy in such a way that the production of biofuel could not affect the production of food grain to maintain food security. Waste and barren land should be used in the production of biomass other than agriculture land

- Govt. should educate former about biofuel and way of its cultivation and production.
- Govt. can subsidies biofuel.
- Minimum support prize should be given to the former producing biomass for biofuel.
- Research and development should be promoted
- Capacity building by organizing workshops and seminars
- Govt. can develop public privet partnership model in this field.
- Govt. can help in financing of development of infrastructure in this field
- Use of petro diesel should be prohibited in highly polluted city like Delhi.

7. CONCLUSION

Critically increasing air pollution by vehicles in cities has imposed hazardous health consequences which shows the urgency of alternative fuel solution like biofuel. Policy maker should have serious emphasis on this concern to promote sustainability of environment.

8. ACKNOWLEDGEMENTS

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